Bentgrass Greens Mix Establishment Trial 2001-2005

Casnoff-Austein-Casnoff Associates Davidsonville, Maryland

CASNOFF-AUSTEIN CASNOFF ASSOCIATES

ABSTRACT

THE PENNFIELD TURFGRASS CONSTRUCTION SYSTEM
By David M Casnoff, Ph.D. January 9, 2003

The Pennfield System is an environmentally sensitive construction method for turfgrass fields such as golf greens and professional sports fields that takes the Purr-Wick System ideals created in the nineteen-sixties and reformulates those ideals with 21st century technologies. The potential benefits to the environment include reduced pesticide and water inputs.

INTRODUCTION

Within the last 10 years, there have been several pesticide, fertilizer and water restrictions placed on turfgrass managers. Turfgrass managers all over the country are tackling these restrictions in many unique manners. The Pennfield system is one of many ideas on construction methodology that is based on the concepts of reduced water use, increased usage of recycled natural resources, and reduced pesticide inputs.

There are approximately 400,000 tons of raw chicken manure produced by the poultry industry in the state of Maryland each year. Several ideas have been proposed to utilize this waste product in agricultural production in order to mitigate its environmental impact on the Chesapeake Bay and the Bay's associated industries. Raw poultry manure over-usage in agricultural production was implicated as one of the major causes of the pfiesteria outbreak in several states over the last several years, including several tributaries feeding the Chesapeake Bay. The main suspected cause was the runoff and leaching of both nitrates and phosphates from fields that were overloaded due to the overuse of raw poultry manure. This is not only a problem in Maryland, but also the entire East Coast. The composting of such wastes has been shown to stabilize the nitrates and phosphates such that the runoff and leaching of these nutrients into surface and ground water will be kept in check. Several studies have shown that these composted products have produced lower levels of runoff and leaching as compared to inorganic fertilizer products. In response to comments directed at the golf course and other turf industries by Maryland's Governor Glendening as well as other states' government officials, specifically in the area of "environmentally sensitive use of fertilizers on large turfed areas such as golf courses and recreational sports fields", the Pennfield System study was initiated.

The use of water and pesticides are the other major factors in the maintenance of golf courses and other sports field areas that has been targeted for restrictions. The turfgrass geneticists have made some great strides in identifying new bentgrass, bluegrass, perennial ryegrass, and bermudagrass varieties that will need less water for survival and still create very good playability conditions. There has been much effort in the irrigation industry to develop new technologies that can also help to reduce the water used. With the onset of drought conditions showing up in a large percentage of the U.S., this has become a major priority. Drip irrigation systems have been shown to reduce water use

in certain agricultural systems by half. In research done by Bernd Leinauer, Ph.D.,[1][1] water use on subsurface-irrigated research plots was shown to be 90-95 percent less than on sprinkler-irrigated plots. These subsurface-irrigated plots also had root masses greater at lower depths than those irrigated with conventional sprinkler systems. If these systems could be used in the golf course and sport field industries, they could make a great contribution to water savings in the new millennium. In addition , the use of composted manures and watering systems that can introduce water below the surface and keep the soil surface and turf thatch layers less hydrated could help in the reduction of disease and reduce the use of pesticides as a benefit.

WHAT IS THE PENNFIELD SYSTEM AND WHERE CAN IT BE USED?

The Pennfield System is a field construction method that uses the concepts set up by the Purr-Wick System developed in 1966[2][2] , and utilizes new high and low technologies developed in recent years. The components of the Pennfield System are as follows:

- A pond liner that is used to allow water to be collected from irrigation runs or ambient rainfall events. The liner is a low volume polyethylene product that is light weight and very durable.
- A subsurface irrigation and a subsurface aeration delivery systems that were developed and manufactured by Precision Porous Pipe (a division of Colorite Plastics). The regenerative blower used to force air through the soil profile was manufactured by Gast.
- A flat pipe drainage system developed by ADS used not only to drain the soil but also as the main component in the capabilities to recycle water resources.
- A micro injection unit to inject pesticides, fertilizers, and soil amendments at very precise rates, and a recycling pump unit to help recycle water from collection tanks back to the field or green. The design and the units will be developed by Moyer Golf.
- A soil mixture developed for the Pennfield System which contains 85% sand (USGA Specifications), 12% Canadian Sphagnum Peat, and 3% aerobically composted turkey manure (2-3-3 ratio of N, P_2O_5 , and K_2O, developed by Sustane Natural Fertilizer, Inc,).
- A moisture monitoring and valve control system and the software to completely run the guts of the Pennfield system. The company that helped in the development of this control system is Adcon Telemetry with the help of several third party contributors.
- A conventional part of the irrigation system that will be used to supplement the subsurface system during the most stressful times during the year (summer) if needed, and to help in the cooling process via syringing and the watering-in process for topically applied fertilizers, pesticides, etc…

The future applications for the Pennfield system will be golf greens, golf tee complexes, professional fields, and other high end sports fields such as college and high school stadium fields. Parts of this

system have been used successfully in park and recreation sports fields as well as high school practice fields.

CONSTRUCTION METHODS AND MATERIALS USED FOR GOLF GREEN CONSTRUCTION

The construction of the Pennfield golf green starts in much the same way as a California Style green or a USGA Specification green. An experienced excavator will create a sub-grade that will mirror the grade of the surface. The depth of the sub-grade will be 12" throughout the entire profile of the green. The edges of the green should be tapered so as not to have an abrupt transition from the green to the approach. The piping for the recycling system is installed. These pipes will be connected to the collection tanks that will be used to collect the water from irrigation runs and ambient rainfall. Once this excavation is done, the low volume polyethylene liner is installed. This type of liner is very easy to work with since it is light weight and extremely durable. Holes can be cut into this material to accept pipes for irrigation, aeration, and drainage. The holes are then sealed water-tight using a material specifically made for this process. The irrigation, aeration, and drainage systems are constructed on top of the liner. The figure (Figure 1) below shows this stage completed.

Summary Conclusions: Bentgrass Greens Mix Establishment Trial 2001

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- Substitution of 3% of the peat content in a modified 85:12:3 USGA type (sand-peat-Sustâne) putting green with Sustâne natural fertilizer **resulted in a 360% increase* in turf cover** at 21 and 30 days after seeding when compared to the typical 85:15 sand-peat mix with standard starter fertilizers. *83.5% turf cover within 30 days on Sustâne treatment vs. 23.3% turf cover in the non-Sustâne. (See photo 1, taken 30 days post seeding, June 4, 2001.

- Water infiltration rates, capillary and non-capillary porosity, water holding capacity, organic matter content, root mass and feeder roots **all increased in the 85:12: 3 Sustâne treated plots**. [See Table: Physical Characteristics.]

- Incidence of first year **disease pressure was non-existent** on the Sustâne amended greens mix (85:12:3) compared to the synthetically fertilized control.

- The Sustâne treatment (85:12:3) received no additional fertilizer during grow-in. Turf establishment was significantly enhanced on the Sustâne amended profile through increased tillering. There was a major reduction in the incidence of Dollar Spot in the Crenshaw Creeping Bentgrass in the forced aeration plus Sustâne treatments.

- In 2005, four years after establishment the treatment effect of the initial soil mix containing 3% Sustâne 2-3-3 by weight provided sufficient protection against Pythium blight. The turf quality on the non-Sustâne amended soil mix declined to the extent that all turf required removal and reseeding. Conversely, turf grown on the Sustâne amended soil mix suffered only minor decline and fully recovered within three weeks. (See photo illustrations.)

Research Illustrating Rate of Turf Establishment, Turf Density and Long Term Disease Suppression with Suståne Natural

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June 4, 2001: *30 days* after seeding May 11 on five different bentgrass varieties

USGA 85:15 Sand/Peat Mix	USGA 85:12:3 Sand/Peat/Suståne
Synthetic Starter Fertilizers = 1.8 lb. N	Suståne 2-3-3 Fertilizer = 1.8 lb. N per 1,000
+ 10 - 10 - 10 at 3/4 lb. N / 1,000 $ft.^2$ as pre-seeder + 18 - 24 - 12 at 1/4 lb. N / 1,000 $ft.^2$ at seeding + 18 - 24 - 12 at 1/4 lb. N / 1,000 $ft.^2$ at 14 days + 18 - 24 - 12 at 1/4 lb. N / 1,000 $ft.^2$ at 28 days	No supplemental fertilizer

This photograph taken only 30 days after seeding illustrates the significant treatment effect difference in rate of, density, and quality of turf establishment between the conventional fertilizer regime (on left) vs. the Suståne treatment incorporated into soilmix (on right) in a USGA type constructed sand putting green. Fertilizer source represents the only difference in plots.

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Long lasting turf density with Sustâne

2 USGA Soil mixes Showing Treatment Differences in Turf Density on Bentgrass Green 3½ years after seeding

Photo taken 10-27-04: 3½ years after seeding turf density and quality differences are still very evident between treatments. Identical fertilizer and fungicide regime on both plots. Minimal disease pressure on Sustâne amended soilmix since seeding

3½ Years after seeding bentgrass green **No Sustâne** in soil profile.

3½ years after seeding bentgrass green **Sustâne used** in soil profile.

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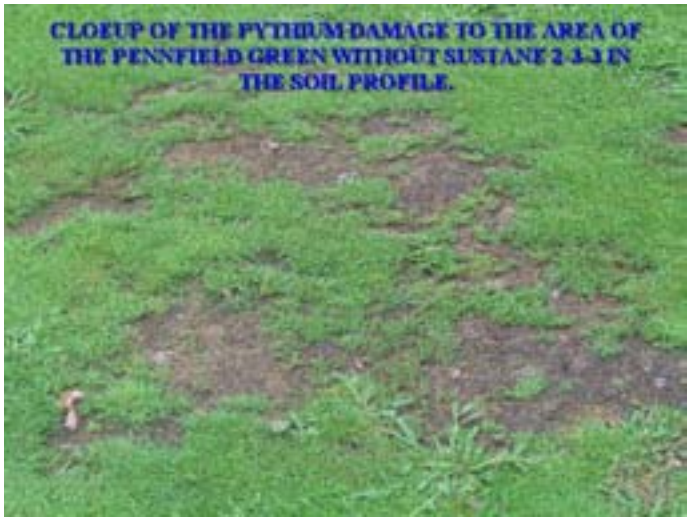
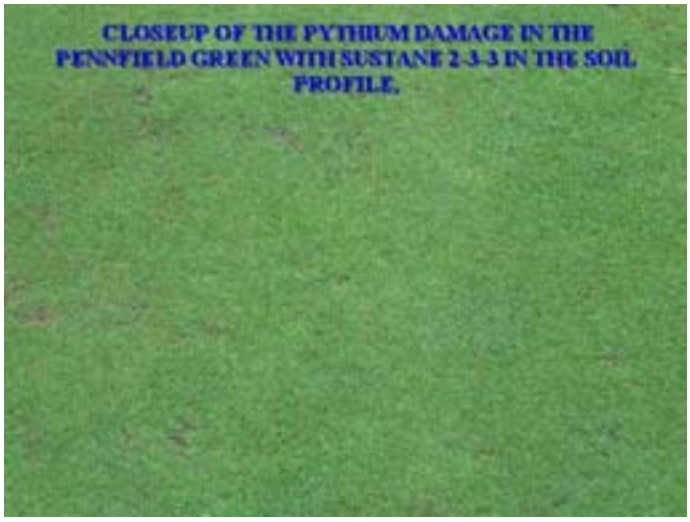
Experimental Green – 3 years after construction. Side-by-Side Treatments.
Upper half of photo – No Suståne in Soil Profile
Lower half of photo – 3% Suståne 2-3-3 mixed into soil profile



Pythium damage on Bentgrass. No Suståne in Soil Profile August 10, 2004.



Pythium damage on Bentgrass. Suståne in Soil Profile August 10, 2004.

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Physical characteristics of each of the three soil profile-air treatment combinations, six months after seeding

Table 1 shows the physical characteristics of each of the three soil profile-air treatment combinations, six months after seeding. The initial differences in soil physical characteristics are significant between Sustâne amended and non-Sustâne amended soil profiles.

Water infiltration rates, capillary and non-capillary porosity, water holding capacity, organic matter content, root mass and feeder roots **all increased in the 85:12: 3 Sustâne treated plots**.

Table1. Physical characteristics of each of three soil profile/air treatment combinations.

	Sustane with Forced Air	No Sustane with Forced Air	Sustane No Forced Air	Well-Drained Greens - Ideal values
Infiltration Rate (in/hr)	15.96	11.15	6.35	6 to 10
Subsurface Air Capacity (Non Capillary Porosity)	29.07%	26.58%	23.43%	~ 20%
Water Porosity (Capillary)	18.15%	16.53%	20.86%	15% to 20%
Bulk Density (g/cc)	1.31	1.40	1.37	1.40 to 1.50
Water Holding	13.82%	11.83%	15.22%	10% to 15%
Organic Content ¼ to 1 in.	0.85%	0.42%	0.72%	1.5 to 2.5%
Organic Content 1 to 2 in.	0.72%	0.66%	0.67%	1.0% to 2.0%
Organic Content 2 to 3 in.	0.62%	0.72%	0.77%	0.5to 2.0%
Organic Content 3 to 4 in.	0.75%	0.69%	0.79%	0.5% to 1.5%
Root Mass	¾ in.	5/8 in.	¾ in.	At least ½ in.
Feeder Roots	Medium at 3 in.	Sparse at 3.5 in.	Sparse at 3 in.	At least 3.5 in. - medium density

All data were generated by the International Sports Turf Research Center located in Olathe, Kansas.

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Fertilizer and Fungicide Maintenance History

2001 – Grow In for Chemical Fertilizer Treatment

Fertilizer Rate	Product	Date	Pesticide applications	Date
0.75 lb. N / 1000 sq. ft.	10-10-10	5/08/01 pre-seeder		
0.25 lb. N / 1000 sq. ft.	18-24-12	5/11/01at seeding		
0.25 lb. N / 1000 sq. ft.	18-24-12	6/24/01		
0.25 lb. N / 1000 sq. ft.	18-24-12	7/08/01	No pesticides applied in 2001	
1.8 lb. N / 1000 sq. ft. total starter		Synthetic Starter Fertilizer Plot		

2001 – Grow In for Sustâne Treatment

1.8 lb. N / 1000 sq. ft. equivalent from		Sustâne Amended Plot – no supplemental fertilizers		
1 lb. N /1000 sq ft.	Sustâne 5-2 4+Fe	11/12/01	All plots	

2002 - Maintenance Treatments for All Plots

Fertilizer Rate	Product	Date	Pesticide applications	Date
1 lb. N /1000 sq ft.	Sustâne 5-2 4+Fe	4-4-2002	Bayer - Granular Bayleton	4/04/02
1 lb. N /1000 sq ft.	Sustâne 12-2-8	5-23-2002	Bayer - Granular Bayleton	5/10/02
1 lb. N /1000 sq ft.	Sustâne 12-2-8	8-29-2002	Heritage	7/02/02
0.5 lb. N /1000 sq ft.	Sustâne 5-2 4+Fe	10-1-2002	Heritage	8/01/02
			Heritage	8/30/02
0.5 lb. N /1000 sq ft.	Sustâne 5-2 4+Fe	11-15-2002	No diseases were seen in 2002	

2003 - Maintenance Treatments for All Plots

Fertilizer Rate	**Product**	**Date**	**Pesticide applications**	**Date**
1 lb. N /1000 sq ft.	Sustâne 5-2 4+Fe	4-6-2003	Bayer - Granular Bayleton	4/20/03
1 lb. N /1000 sq ft.	Sustâne 5-2 4+Fe	5-15-2003	Bayer - Granular Bayleton	5/20/03
.1 lb. N / 1000 sq. ft.	Daniels 10-3-5	every 2 weeks 6/28 - 8/3/03	Heritage	7/03/03
0.5 lb. N / 1000 sq. ft.	Sustâne 10-2-10	9-15-2003	Dollar spot pictures taken	9/03/03
1 lb. N /1000 sq ft.	Sustâne 5-2 4+Fe	11-14-2003	No Pythium was seen in 2003	

2004 - Maintenance Treatments for All Plots

Fertilizer Rate	Product	Date	Pesticide applications	Date
1 lb. N /1000 sq ft.	Suståne 5-2 4+Fe	4-6-2004	Bayleton	4/09/04
1 lb. N /1000 sq ft.	Suståne 5-2 4+Fe 5-10-2004		Bayleton	5/15/04
.1 lb. N / 1000 sq. ft.	Daniels 10-3-5	every 2 weeks 6/29 – 8/24/04		
			Pythium appeared on Pythium photographed	8/02/04 8/10/04
			No pesticides applied for control	
0.5 lb. N / 1000 sq. ft.	Suståne 10-2-10	9-18-2004	Bayleton	9/10/04
1 lb. N / 1000 sq ft.	Suståne 5-2 4+Fe	11-6-2004		

In all cases of diseased turf, recovery was seen in the early fall. The plots with severe disease pressure required reseeding and several weeks to recover. The experimental putting green plot grown in with Suståne 2-3-3 amended into the soil profile at 3% of the volume required no reseeding to recover from the minimal damage incurred by Dollar spot or Pythium.